/ ***Marley MD*** *Cooling Tower* /

User Manual 08-1616A

SPX
COOLING TECHNOLOGIES

Contents

Note

This manual contains vital information for the proper installation and operation of your cooling tower. Carefully read the manual before installation or operation of the tower and follow all instructions. Save this manual for future reference.

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product. Also, please observe all Caution and Warning labels on the tower.

⚠ Warning

Indicates presence of a hazard which can cause severe personal injury, death or substantial property damage if ignored.

⚠ Caution

Indicates presence of a hazard which will or can cause personal injury or property damage if ignored.

Note

Indicates special instructions on installation, operation or maintenance which are important but not related to personal injury hazards.

Preparation

The **Marley MD** cooling tower purchased for this installation represents the current state of the art in counterflow, induced draft cooling tower design. Thermally and operationally, it is the most efficient cooling tower of its class.

These instructions—as well as those offered separately on motors, fans, controls, vibration switches, etc.—are intended to assure that the tower serves you properly for the maximum possible time. Since product warrantability may well depend upon your actions, please read these instructions thoroughly prior to operation.

If you have questions about the operation and/or maintenance of this tower, and you don't find the answers in this manual, please contact your Marley sales representative. When writing for information, or when ordering parts, please include the serial number shown on the tower nameplate.

Safety First

The location and orientation of the cooling tower can affect the safety of those responsible for installing, operating or maintaining the tower. However, since SPX Cooling does not determine the location or orientation of the tower, we cannot be responsible for addressing those safety issues that are affected by the tower's location or orientation.

⚠ Warning

The following safety issues should be considered by those responsible for designing the tower installation.

- ***access to and from the collection basin***
- ***access to and from mechanical access door***
- ***the possible need for ladders (either portable or permanent) to gain access to the mechanical access doors***
- ***the possible need for external mechanical access platforms***
- ***potential access problems due to obstructions surrounding the tower***
- ***lockout of mechanical equipment***
- ***the possible need for safety cages around ladders***
- ***the need to avoid exposing maintenance personnel to the potentially unsafe environment inside the tower.***

Those are only some of the safety issues that may arise in the design process. SPX strongly recommends that you consult a safety engineer to be sure that all safety considerations have been addressed.

Preparation

Several options are available that may assist you in addressing some of these personnel safety concerns, including:

— mechanical access platform and ladder

— ladder extensions (used where the base of the tower is elevated)

— inclined mechanical access ladders

— safety cages for ladders

— motor located outside the tower

Tower Location

Space available around the tower should be as generous as possible to promote ease of maintenance—and to permit freedom of airflow into and through the tower. If you have questions about the adequacy of the available space and the intended configuration of the tower, please contact your Marley sales representative for guidance.

Prepare a stable, level support foundation for the tower, utilizing weight, wind load, and dimensional information appearing on appropriate Marley submittal drawings. Supports must be level to insure proper operation of the tower.

⚠ Warning

The cooling tower must be located at such distance and direction to avoid the possibility of contaminated tower discharge air being drawn into building fresh air intake ducts. The purchaser should obtain the services of a Licensed Professional Engineer or Registered Architect to certify that the location of the tower is in compliance with applicable air pollution, fire, and clean air codes.

Tower Shipment

Unless otherwise specified, MD cooling towers ship by truck (on flat bed trailers), which lets you receive, hoist, and install the tower in one continuous operation. Single-cell towers ship on one truck. Multicell towers, depending on their size, may require more than one truck.

Responsibility for the condition of the tower upon its arrival belongs to the truck driver—as does the coordination of multiple shipments, if required. Each tower has recommended tie down instructions by which they should be secured to the flatbed. Drivers should follow these instructions when securing the tower to the flat-bed.

Receiving and Hoisting

Receiving Tower

Prior to unloading the tower from the delivering carrier, inspect the shipment for evidence of damage in transit. If damage is apparent, note the freight bill accordingly. This will support your future recovery claim.

Find and remove the installation instruction drawings and bills of material located in a plastic container in the cold water basin. This information should be kept for future reference and maintenance purposes.

Hoisting Tower

All models consist of two modules per cell. Both modules have hoisting clips. Detailed hoisting drawing are included in the literature package.

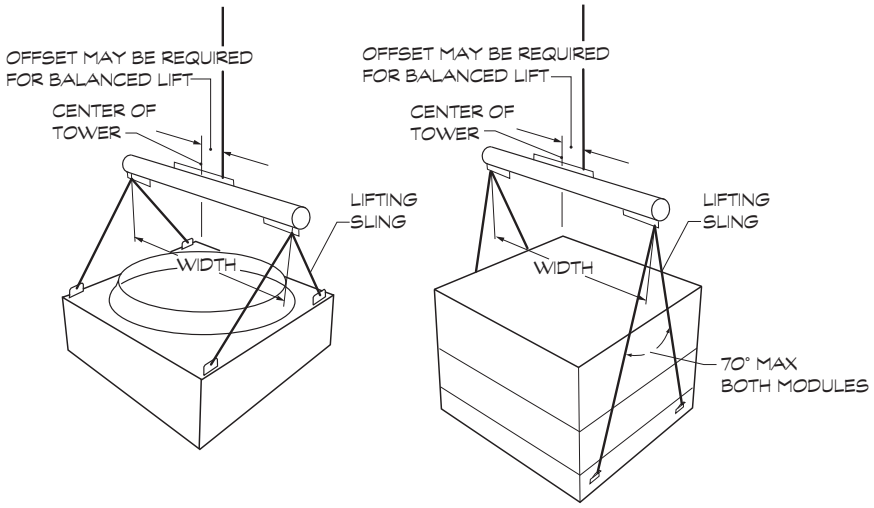
⚠ Caution

MD upper and lower modules must be hoisted and set separately. Do not preassemble modules prior to hoisting.

A **Hoisting-Installation** label which has hoisting dimensional information is located on the side casing of the tower modules. Remove tower from the carrier and hoist into place according to the instructions on the label.

⚠ Warning

Hoisting clips are provided for ease of unloading and positioning tower. For overhead lifts or where additional safety is required, safety slings should also be placed under the tower. Under no circumstances should you combine the top and bottom modules of modular models and attempt to hoist them at the same time by utilizing the hoisting clips alone!



Installation

Tower Installation

Note

These installation instructions are intended to help you prepare before your tower arrives. If discrepancies exist between these instructions and those shipped with the tower, the instructions shipped with the tower will govern.

1. Prior to placement of the tower, confirm that the supporting platform is level, and that the anchor bolt holes are correctly located in accordance with Marley drawings.
2. Place bottom module on your prepared supports, aligning anchor bolt holes with those in your supporting steel. Make sure that the orientation agrees with your intended piping arrangement. Attach tower to supporting steel with four ⅝" diameter bolts and flat washers (by others). Position flat washers between the bolt head and the tower bottom flange.
3. Before setting top module in place on bottom module, clean any debris from the top of the bottom module. Ensure that the fill surface is free from debris and all fill packs are level. Recommended tie-down instructions are provided to the truck driver upon tower pickup. If damage occurs to the tower due to tie-down procedures other than those recommended in the drawing, it should be noted upon arrival. Remove the protective paper off the sealing gasket tape before setting the top module and ensure there is coverage around the entire perimeter. Place the top module on the bottom module, aligning mating holes as it is set in place. Make sure that the orientation of the top module agrees with your intended piping arrangement. Sections are 180° reversible with respect to each other. Pay close attention to face designations on sales orientation drawings e.g. Face A, Face B, etc. Use drift pins to align bolt holes during the assembly of the top and bottom modules as the top is lowered into place. Use care when setting the modules as lifting and resetting the top module will compromise the sealing gasket between the two sections, possibly resulting in a leaking joint. If the top module must be reset, it may be necessary to remove the sealing gasket tape and replace.

Note

Gasket details must be followed correctly or leaks may occur that will not be covered under warranty.

4. Attach top module to bottom module with fasteners provided—according to **"MD Field Installation Manual"**.

Installation

Note

If tower purchased is one fan cell only, ignore steps 4 through 8.

5. If collection basins are to be equalized by the use of Marley standard flumes, unbolt the coverplate from the basin of the cell just installed. The coverplate is located in the collection basin depressed section end.
6. Unbolt temporary coverplate from the basin of the second cell and set the bottom module of the second cell in place. Align anchor bolt holes and flume openings in basin sides.
7. Install flume according to **"MD Field Installation Manual"**.

Note

It is important that the cells be firmly anchored before the flume is attached to the 2nd cell.

8. Repeat steps 2 through 4 for the second top section.
9. Repeat steps 5 through 8 for any remaining cells.
10. Attach your cold water supply piping to the cold water basin outlet connection in accordance with drawing instructions. Use gaskets where recommended.

⚠ Caution

Do not support your pipe from the tower or outlet connection—support it externally.

Normally, one of the following three outlet arrangements is provided:

Side or End suction connection: This is a factory-installed, galvanized pipe nipple, extending horizontally from the side or end of the cold water basin. It is both beveled for welding—and grooved for a mechanical coupling. If a weld connection is used, it is recommended that the weld area be protected against corrosion. Cold galvanizing is suggested, applied according to the manufacturer's instructions.

Bottom outlet connection: This is a factory-installed, circular opening in the cold water basin floor of one or more cells. An appropriately sized circular opening has been drilled to 125# ANSI B16.1 flat-face flange specifications. A full faced gasket and appropriately sized bolts (by others) must be used for proper outlet function.

Side outlet sump connection: For shipping purposes, sumps are attached upside down in the basin to prevent damage. Sumps are to be

installed in the square opening in the floor of the cold water basin of one or more cells—sealed against leakage, and attached by machine bolts, according to the installation drawing included. An appropriately sized circular opening in the vertical face of the sump has been drilled to 125# ANSI B16.1 flat-face flange specifications. A full faced gasket and appropriately sized bolts (by others) must be used for proper distribution.

10 Attach makeup water supply piping to appropriately sized float valve connection located in cold water basin. Tower drain and overflow connections are located on the side of the collection basin. If you wish to pipe overflow and drain water to a remote discharge point, make those connections at this time also.

11. Attach your warm water return piping to the inlet connection of the tower.

Note

Fasteners and components provided by others that are to be attached to the tower must be compatible with the cooling tower materials—e.g. fasteners in a stainless steel cold water basin must be stainless steel.

⚠ Caution

Except for the horizontal components of piping, do not support your pipe from the tower inlet connection—support it externally.

Normally, one of the following two inlet arrangements is provided:

Bevel and groove distribution connection: This is a factory-installed, galvanized pipe nipple, extending horizontally from the side of the tower. It is both beveled for welding—and grooved for a mechanical coupling. If a weld connection is used, it is recommended that the weld area be protected against corrosion. Cold galvanizing is suggested, applied according to the manufacturer's instructions.

Flanged distribution connection: The spray system is fitted with a flat-face flange connection that conforms to 125# ANSI B16.1 specifications. A full faced gasket and appropriately sized bolts (by others) must be used for proper distribution function.

12. Wire motor in accordance with wiring diagram.

⚠ Warning

For maintenance/safety purposes, SPX recommends a lockout type disconnect switch for all mechanical equipment. In addition to a disconnect switch, the motor should be wired to main power supply through short circuit protection, and a magnetic starter with overload protection.

Installation

Motor Wiring

Wire motor leads as shown on the motor nameplate matching the supply voltage. Do not deviate from the motor nameplate wiring.

Either of following symbols may be shown on the motor nameplate – Δ, Δ Δ, Y, or YY. These symbols represent how the motor is constructed on the inside and in no way have anything to do with a Delta or Wye electrical distribution system serving the motor.

When using a starter:

- Set motor overload protection to 110% of motor nameplate amps. This setting allows the fan motor to operate during cooler weather. During cooler weather it is common for the motor to draw 6 to 10% higher than nameplate amps. High amps are common during tower commissioning when the tower is dry and the ambient air temperature is cool.
- Do not start the motor more than ***six*** times per hour. Short cycling the tower will cause fuses, breakers or O.L.s to operate and will decrease motor life.

When using a *two-speed* starter:

- Motor rotation must be the same at slow speed and high speed.
- Single winding motor requires a starter with a shorting contactor.
- Two-winding motor requires a starter with out a shorting contactor.
- All two-speed starters must have a 20 second time delay relay when switching from high speed to low speed.
- Do not start the motor more than ***six*** times per hour (each low speed start and each high speed start count as one start).

When using a VFD:

Note

Before beginning, ensure that the motor is rated for "Inverter Duty" per NEMA MG-1, part 31.

- Set the VFD solid state overload protection to 119% of motor nameplate amps and set "maximum current parameter" in the VFD to motor nameplate amps. "Maximum current parameter" will reduce fan speed and limit amp draw to nameplate amps during cold weather operation. If furnished with a mechanical O.L. set this at 110% over motor nameplate amps.
- Motor rotation must be the same in both VFD mode and By-pass mode.

Installation

- If cable distance between the VFD and motor is greater than 100 feet a DV/DT output filter is recommended to avoid damage to the motor. 100 feet distance is based on our field experience, the VFD manufacture may state different distances and distance does vary depending on the VFD manufacture.
- Program the VFD for variable torque output. Flux vector and constant torque modes may damage the gearbox.
- Do not start and stop the motor using the safety switch at the motor. If the drive is being commanded to run and the load side is cycled ON and OFF with the safety switch this may damage the VFD.

Using a VFD in cooling applications has advantages over traditional single or two speed motor control. A VFD can reduce the cost of electrical energy being used and provide better temperature control. In addition, it reduces the mechanical and electrical stress on the motor and mechanical equipment. Electrical savings can be large during periods of low ambient temperature when the cooling requirement can be satisfied at reduced speeds. To benefit from these advantages, it is important that the drive be installed correctly.

Marley supplies VFD and VFD controls specifically designed for our cooling products. If you have purchased a Marley VFD and/or controls package, please follow the instructions in the User Manual for that system. Most VFD problems can be avoided by purchasing the Marley drive system. If you are installing a VFD other than the Marley drive, please refer to that drives installation manual.

⚠ Warning

Improper use of a VFD may cause damage to equipment or personal injury. Failure to correctly install the VFD drive will automatically void all warranties associated with the motor and any equipment that is either electrically or mechanically (directly) attached to the VFD drive system. The length of this warranty avoidance will be contingent on properly installing the VFD system and repairing any damage that may have occurred during its operation. SPX Cooling Technologies does not assume responsibility for any technical support or damages for problems associate with non-Marley brand VFD systems.
Changing the operational fan speed from the factory settings could cause the fan to operate in an unstable region which may result in damage to the equipment and possible injury.

Installation

Mechanical Equipment:

⚠ Warning

Always shut off electrical power to the tower fan motor prior to performing any maintenance on the tower. Any electrical switches should be locked out and tagged out to prevent others from turning the power back on.

1. Spin the fan manually to assure that all fan blades properly clear the inside of the fan cylinder. For belt drive equipped models observe the action of the sheaves and belts to be sure that the motor is properly aligned with the fan sheave. If necessary, correct the alignment in accordance with the Belt Tensioning and Sheave Alignment section on pages 21 and 24.

⚠ Warning

The following steps require operation of the fan motor while the access door is open. DO NOT view the fan operation from near or inside the access door location. Fan rotation should be viewed from tower grade.

⚠ Caution

The access door should NOT be opened while the fan is operating. The fan rotation causes a negative pressure inside the cooling tower and will abruptly pull the door open should access be attempted. Only open the cooling tower access door when the fan is off and locked out.

2. Momentarily bump (energize) the motor and observe rotation of the fan. The fan should rotate in a counterclockwise direction when viewed from below. If rotation is backwards, shut off the fan and reverse two of the three primary leads supplying power to the motor.

⚠ Caution

If tower is equipped with a two-speed motor, check for proper rotation at both speeds. Check also to see that starter is equipped with a 20 second time delay which prevents direct switching from high speed to low speed. If the fan is intended to be reversed for deicing purposes, make sure that the starter is equipped with a 2 minute time delay between changes of direction. These delays will prevent abnormal stress from being applied to the mechanical equipment and the electrical circuit components.

3. Run the motor and observe the operation of the mechanical equipment. Operation should be stable.
4. Check belt tension and torque on the fan and motor sheave after 10 to 60 hours of operation. See Bushing Fastener Torque Values on page 25.

Note

If the water supply system is not being operated—or if there is no heat load on the system—motor amps read at this time may indicate an apparent overload of as much as 10–20%. This is because of the increased density of unheated air flowing through the fan. Determination of an accurate motor load should await the application of the design heat load.

Tower Start-Up

⚠ Warning

Among other sources, outbreaks of Legionnaires' Disease have reportedly been traced to cooling towers. Maintenance and water treatment procedures that prevent amplification and dissemination of Legionella and other airborne bacteria should be formulated and implemented BEFORE systems are operated and continued regularly thereafter to avoid the risk of sickness or death.

Water System:

1. New installations should be cleaned and treated with biocides by a water treatment expert before startup.
2. Remove any and all accumulated debris from tower. Pay particular attention to inside areas of cold water basin, louvers and drift eliminators. Make sure that cold water suction screens are clear and properly installed.
3. Fill the water system to an approximate depth of 7" in the depressed area of the cold water basin at the center of the tower. This is the recommended operating water level. Adjust the float valve so that it is 75% open at that level. Continue filling the system until the water reaches a level approximately ⅛" below the lip of the overflow.

Note

If tower is equipped with a side or end suction connection, vent accumulated air from the top of the suction hood by removing one or both tap screws provided at that location. Replace these tap screws when venting is complete.

4. Completely open all hot water flow control valves. Start your pump(s) and observe system operation. Since the water system external to the tower will have been filled only to the level achieved in the cold water basin, a certain amount of "pump-down" of the basin water level will occur before water completes the circuit and begins to fall from the fill. The amount of initial pump-down may be insufficient to cause the float valve to open. However, you can check its operation by pressing down on the operating lever to which the stem of the float valve is attached.

   Some trial and error adjustment of the float valve may be required to balance the makeup water with tower operation. Ideally, the float valve setting will be such that no water is wasted through the overflow at pump shutdown. However, the water level after pump start-up must be deep enough to assure positive pump suction.

6. Continue pump operation for about 15 minutes, after which it is recommended that the water system be drained, flushed, and refilled.

7. While operating the condensing water pump(s) and prior to operating the cooling tower fan, execute one of the two alternative biocidal treatment programs described in the following:
   - Resume treatment with the biocide which had been used prior to shutdown. Utilize the services of the water treatment supplier. Maintain the maximum recommended biocide residual (for the specific biocide) for a sufficient period of time (residual and time will vary with the biocide) to bring the system under good biological control

     or
   - Treat the system with sodium hypochlorite to a level of 4 to 5 mg/L free chlorine residual at a pH of 7.0 to 7.6. The chlorine residual must be held at 4 to 5 mg/L for six hours, measurable with standard commercial water test kits.

   If the cooling tower has been in operation and then shut down for a duration of time and not drained, perform one of the two previous biocidal treatment programs directly to the cooling water storage vessel (cooling tower sump, drain down tank, etc.) without circulating stagnant water over the cooling tower fill or operating the cooling tower fan.

   After biocidal pretreatment has been successfully completed, cooling water may be circulated over the tower fill with the fan off.

   When biocidal treatment has been maintained at a satisfactory level for at least six hours, the fan may be turned on and the system returned to service. Resume the standard water treatment program, including biocidal treatment.

Operation

Tower Operation

General:

The cold water temperature obtained from an operating cooling tower will vary with the following influences:

1. **Heat load:** With the fan in full operation, if the heat load increases, the cold water temperature will rise. If the heat load reduces, the cold water temperature will reduce.

   Note that the number of degrees ("range") through which the tower cools the water is established by the system heat load and the amount of water being circulated, in accordance with the following formula:

$$\text{Range} - °F = \frac{\text{Heat Load (Btu/hr)}}{\text{GPM x 500}}$$

   The cooling tower establishes only the cold water temperature attainable under any operating circumstance.

2. **Air wet-bulb temperature:** Cold water temperature will also vary with the wet-bulb temperature of the air entering the louvered faces of the tower. Reduced wet-bulb temperatures will result in colder water temperatures. However, the cold water temperature will not vary to the same extent as the wet-bulb. For example, a 20°F reduction in wet-bulb may result in only a 15°F reduction in cold water temperature.
3. **Water flow rate:** Increasing the water flow rate (GPM) will cause a slight elevation in cold water temperature, while reducing the water flow rate will cause the cold water temperature to decrease slightly. However, at a given heat load (see formula above), water flow reductions also cause an increase in the incoming hot water temperature. Use care to prevent the hot water from exceeding 125°F, in order to prevent damage to the tower components.
4. **Air flow rate:** Reducing air flow through the tower causes the cold water temperature to rise. This is the approved method by which to control leaving water temperature.

   If your tower is equipped with a single-speed motor, the motor may be shut off when the water temperature becomes too cold. This will

cause the water temperature to rise. When the water temperature then becomes too warm for your process, the motor can be restarted.

⚠ Caution

When operating in this mode care must be taken not to exceed a total acceleration time of 30 seconds per hour.

Fan cycling limits: From a dead stop, determine the number of seconds it takes the fan to arrive at full speed. Divide this number into 30 to determine the allowable number of starts per hour. Considering the normal fan and motor sizes utilized on MD towers, anticipate that approximately 4 to 5 starts per hour are allowable.

If your tower is equipped with a two-speed motor, you will enjoy greater opportunity for temperature control. When the water temperature becomes too cold, switching the fan to half-speed will cause the cold water temperature to rise—stabilizing at a temperature a few degrees higher than before. With a further reduction in water temperature, the fan may be cycled alternately from half-speed to off—subject to the same constraint of 30 seconds of allowable acceleration time per hour as outlined above.

If your tower consists of two or more cells, cycling of motors may be shared between cells, increasing your steps of operation accordingly.

Multicell towers equipped with two-speed motors will maximize energy savings and minimize sound levels if fans are staged so that all fans are brought up to low speed before any fan goes to high speed.

For greater insight on cold water temperature control, please read **"Cooling Tower Energy and its Management"**, Technical Report #H-001-A, available on our website.

Wintertime Operation:

During operation in subfreezing weather, the opportunity exists for ice to form in the colder regions of the tower. Your primary concern is to prevent the formation of destructive ice on the cooling tower fill air inlet and louvers. Your understanding of cold weather operation will be enhanced if you read Marley Technical Report H-003 **"Operating Cooling Towers in Freezing Weather"**.

Operation

Note

Slushy, transitory ice forms routinely in the colder regions of the fill at low temperature. Such ice normally has no adverse effect on tower operation, but its appearance should be a signal to the operator to undertake ice control procedures.
It is the operator's responsibility to prevent the formation of destructive (hard) ice on the cooling tower fill and louvers. Certain guidelines should be followed:

1. Do not allow the tower's leaving water temperature to drop below a minimum allowable level—say 36°F to 40°F. If such low temperature operation is necessary or beneficial to your process, establish the minimum allowable level as follows:

   During the coldest days of the first winter of operation, observe whether any ice is forming on the bottom of the fill or the louvers. If hard ice is present on either component, you must increase the allowable cold water temperature. If the coldest possible water is beneficial to your process, ice of a mushy consistency can be tolerated—but routine periodic observation is advisable.

⚠ Caution

If the minimum allowable cold water temperature is established at or near minimum heat load, it should be safe for all operating conditions.

   Having established the minimum allowable cold water temperature, maintaining that temperature can be accomplished by fan manipulation, as outlined in Item 4 under Tower Operation. However, in towers of more than one cell, where fans are manipulated sequentially, please realize that the water temperature will be significantly lower in the cell or cells operating at the highest fan speed than the net cold water temperature produced by the entire tower would indicate. Wintertime operation of multicell towers at low cold water temperature levels requires that the operator be especially watchful.

2. Under extended extreme cold conditions, it may be necessary to operate the fan in reverse. This forces warm air out through the louvers, melting any accumulated ice—adequate heat load must be available. Reversal may be at either full or half speed; however, we recommend reversal at half speed or lower. Reverse operation of the fan should be used sparingly and should only be used to control ice,

not to prevent it. Reverse fan operation should not need to exceed 1 or 2 minutes. Monitoring is required to determine the time required to melt accumulated ice.

⚠ **Warning**

Reverse operation of fans for prolonged periods during subfreezing weather can cause severe damage to fans and fan cylinders. Ice can accumulate inside fan cylinders at fan blade plane of rotation and fan blade tips will eventually strike this ring of ice, damaging the fan blades or cylinder. Ice can also accumulate on fan blades and be thrown off, damaging fan cylinder or blades. Allow a minimum of 10 minute delay between reverse operation and forward operation during subfreezing weather to permit ice to dissipate from fan blades and fan cylinders. See Fan Drive Caution note on page 12 for fan speed change and reversing precautions.

3. With no heat load on the circulating water, icing cannot be controlled effectively by air control during freezing weather. **Towers must not be operated with reduced water rate and/or no heat load during freezing weather.** If the circulating water system cannot be shut down, water returning from the process should be made to bypass the tower. If a bypass is used, **all** water must be bypassed without modulation. If the water bypass is directly into the tower's cold water basin, its design must be approved by SPX Cooling Technologies.

Intermittent Wintertime Operation:

If periods of shutdown (nights, weekends, etc.) occur during freezing weather, measures must be taken to prevent the water in the cold water basin—and all exposed pipework—from freezing. Several methods are used to combat this, including automatic basin heater systems available from Marley.

Unless some means of freeze prevention is incorporated into your system, the tower basin and exposed pipework should be drained at the beginning of each wintertime shutdown period.
If tower basin is drained, verify that all basin heaters have been shut off either by automatic cutoff or disconnect switch.

It is recommended that you discuss your freeze prevention options with your local Marley sales representative.

Operation

Water Treatment and Blowdown

Maintaining Water Quality:

The steel used in MD towers has been galvanized with a heavy zinc coating averaging 2.0 mils in thickness. The MD stainless steel option is even more corrosion resistant than galvanized steel in certain environments. Other materials used (PVC fill, drift eliminators, and louvers, aluminum fans, etc.) are selected to offer maximum service life in a “normal” cooling tower environment, defined as follows:

Circulating water with a pH between 6.5 and 8; a chloride content (as NaCl) below 500 mg/L; a sulfate content (SO4) below 250 mg/L; total alkalinity (as $CaCO_3$) below 500 mg/L; calcium hardness (as $CaCO_3$) above 50 mg/L; a maximum inlet water temperature not to exceed 125°F (51.7°C); no significant contamination with unusual chemicals or foreign substances; and adequate water treatment to minimize scaling.

- Startup Conditions: The water conditions during the initial tower operation are crucial in preventing premature corrosion of galvanized steel (white rust). For at least the first eight weeks of operation, pH should be controlled between 6.5 and 8.0 with hardness and alkalinity levels between 100 and 300 mg/L (expressed as $CaCO_3$).
- Chlorine (if used) shall be added intermittently, with a free residual not to exceed 1 mg/L—maintained for short periods. Excessive chlorine levels may deteriorate sealants and other materials of construction.
- An atmosphere surrounding the tower no worse than “moderate industrial”, where rainfall and fog are no more than slightly acid, and they do not contain significant chlorides or hydrogen sulfide (H_2S).
- Many proprietary chemicals exist for control of scale, corrosion, and biological growth and should be used prudently. Also, combinations of chemicals may cause reactions which reduce treatment effectiveness, and certain chemicals such as surfactants, biodispersants and antifoams may increase drift rate.

Note

Unless you purchased a stainless steel MD, the structure of your MD tower consists primarily of galvanized steel, therefore your water treatment program must be compatible with zinc. In working with your water treatment supplier, it is important that you recognize the potential effects on zinc of the specific treatment program you choose.

Operation

Cooling Tower Cleaning:

⚠ **Warning**

Any evaporative-type cooling tower must be thoroughly cleaned on a regular basis to minimize the growth of bacteria, including Legionella Pneumophila, to avoid the risk of sickness or death. Service personnel must wear proper personal protective equipment during decontamination. Do NOT attempt any service unless the fan motor is locked out.

Operators of evaporative cooling equipment, such as water cooling towers, should follow maintenance programs which will reduce to an absolute minimum the opportunity for bacteriological contamination. Public Health Service officials have recommended that "good housekeeping" procedures be followed, such as: regular inspections for concentrations of dirt, scale, and algae; periodic flushing and cleaning; and the following of a complete water treatment program including biocidal treatment.

The visual inspection should take place at least once a week during the operating season. The periodic flushing and cleaning should be done before and after each cooling season, but in any event at least twice a year. The louvers, drift eliminators, and easily accessible fill surfaces should be flushed by use of a moderate-pressure water nozzle, being careful not to cause physical damage. A reliable water treatment program should be installed and maintained. Filtration devices may be employed to reduce the suspended solids concentrations, thus increasing the effectiveness of the water treatment program. See Tower Startup instructions on page 12.

Blowdown:

A cooling tower cools water by continuously causing a portion of it to evaporate. Although the water lost by evaporation is replenished by the makeup system, it exits the tower as pure water—leaving behind its burden of dissolved solids to concentrate in the remaining water. Given no means of control, this increasing concentration of contaminants can reach a very high level.

In order to achieve water quality which is acceptable to the cooling tower (as well as the remainder of your circulating water system), the selected water treatment company must work from a relatively constant level of concentrations. This stabilization of contaminant concentrations is usually accomplished by blowdown, which is the constant discharge of a portion of the circulating water to waste. As a rule, acceptable levels on which to base a treatment schedule will be in the range of 2-4 concentrations. The following

table shows the minimum amount of blowdown (percent of flow) required to maintain different concentrations with various cooling ranges*:

Cooling Range	Number of Concentrations						
	1.5X	2.0X	2.5X	3.0X	4.0X	5.0X	6.0X
5° F (2.78° C)	.78	.38	.25	.18	.11	.08	.06
10° F (5.56° C)	1.58	.78	.51	.38	.25	.18	.14
15° F (8.33° C)	2.38	1.18	.78	.58	.38	.28	.22
20° F (11.11° C)	3.18	1.58	1.05	.78	.51	.38	.30
25° F (13.89° C)	3.98	1.98	1.32	.98	.64	.48	.38
Multipliers are based on drift of 0.02% of the circulating water rate.							

* Range = Difference between hot water temperature coming to tower and cold water temperature leaving tower.

EXAMPLE: 700 GPM circulating rate, 18°F cooling range. To maintain 4 concentrations, the required blowdown is 0.458% or .00458 times 700 GPM, which is 3.2 GPM.

If tower is operated at 4 concentrations, circulating water will contain four times as much dissolved solid as the makeup water, assuming none of the solids form scale or are otherwise removed from the system.

Note

When water treatment chemicals are added, they should not be introduced into the circulating water system via the cold water basin of the cooling tower. Water velocities are lowest at that point, which results in inadequate mixing.

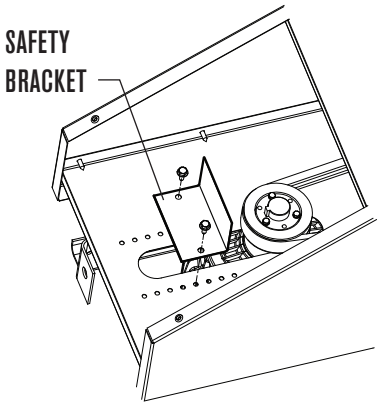
Belt Tensioning

⚠ Warning

Always shut off electrical power to the tower fan motor prior to performing any inspections that may involve physical contact with the mechanical or electrical equipment in or on the tower. Lock out and tag out any electrical switches to prevent others from turning the power back on. Service personnel must wear proper personal protective clothing and equipment.

On the **MD5008** and **MD5010**, the fan motor and belt adjustment mechanism is located outside the tower. Remove the motor protection hood by loosening the two thumbscrews on top and hinge the hood up and out of the way. Also, remove the motor sheave safety bracket and set aside. See the following images.

Maintenance

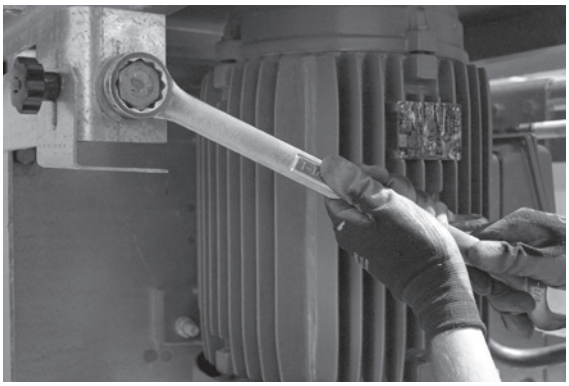


On the **MD5016** the motor is located inside the tower plenum. Open the access door (see Access Door Opening Procedure) and hinge out of the way.

⚠ Caution

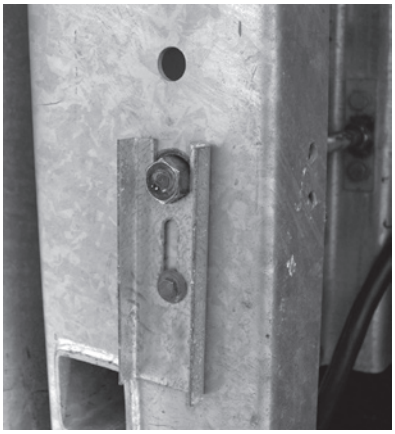
Any bolts removed functioning as mechanical or structural hardware should be replaced with the torques specified below.

Fastener Torque Values				
Machine Bolt Size	Galvanized		Stainless	
	$ft{\cdot}lb_f$	N·m	$ft{\cdot}lb_f$	N·m
8mm	8	10	15	20
10mm	15	20	30	40
12mm	25	35	50	65
16mm	65	85	120	160
20mm	125	170	230	315



Belt tension on all models is adjusted by turning a large threaded rod that drives the motor mounting plate away from (or toward) the fan centerline. To turn this rod, the rod retention bracket must first be moved. On the models with motors located externally loosen the thumbscrew holding this bracket in place and rotate the bracket away from the assembly. On models with the motor located in

Maintenance



the plenum the rod retention is held in place with fasteners. Loosen fastener and slide the bracket away from the adjusting rod. Turn the rod clockwise to drive the motor away from the fan (tighten belts) or counterclockwise to drive the motor toward the fan (loosen the belts). There is no need to loosen any other hardware to adjust the belt tension. After belt tension is adjusted to a satisfactory position, install the rod retention bracket with the thumbscrew and replace any safety hoods.

Ideal tension is the lowest tension at which the belt will not slip under peak load conditions. Check tension frequently during the first 24-48 hours of run-in operation. Overtensioning shortens belt and bearing life. Keep belts free from foreign material which may cause slipping. Never apply belt dressing as this will damage the belt and cause early failure. Specific tools are made to measure the tension of a V-belt drive system. A Dodge® V-Belt Tension Tester, Browning® Belt Tension Checker or equivalent an alternative should be used for tensioning V-belts. Check with you local belt supplier.

Belt tension is measured by applying a force perpendicular to the belt at the center point between motor and fan sheaves. The belt should deflect 1/64 of the entire span, (measured sheave centerline to sheave centerline) when the pressure shown in the table below is applied. Because belt tension is a function of the motor sheave diameter, it is necessary to inspect the motor

sheave to determine the diameter. If diameter markings are unreadable, measure the sheave diameter at the **bottom** of the sheave grooves.

New belts (operating less than 8 hours) should be tensioned to the maximum value. Tension after this period should use no less than the minimum value. If the belt span was measured in inches, then use the pounds of force values. If the belt span was measured in centimeters, then use the kilograms of force values. If specific tensioning instructions are provided with your tensioning tool, those instructions should be used instead.

Motor Sheave diameter	**Used V-Belt** minimum	**New V-Belt** maximum
3.4" - 4.2"	4.9 lb	7.2 lb
85cm - 105cm	2.2 kg	3.3 kg
4.4" - 5.6"	7.1 lb	10.5 lb
106cm - 140cm	3.2 kg	4.8 kg
5.8" - 8.6"	8.5 lb	12.6 l
141cm - 220 cm	3.9 kg	5.7 kg

Sheave Alignment

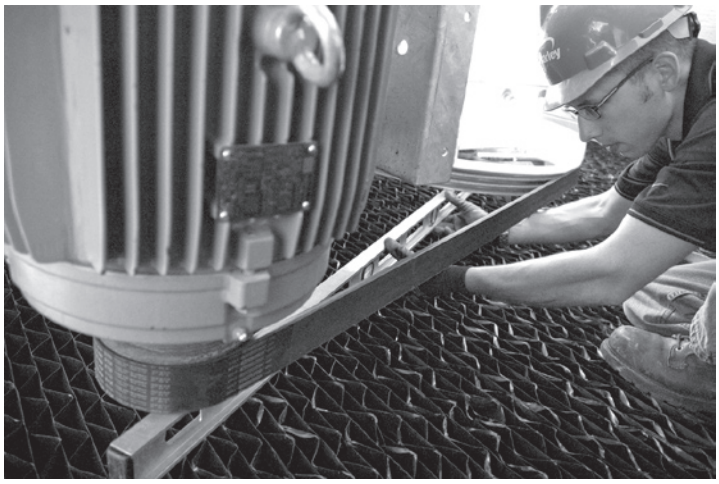
⚠ **Warning**

Always shut off electrical power to the tower fan motor prior to performing any inspections that may involve physical contact with the mechanical or electrical equipment in or on the tower. Lock out and tag out any electrical switches to prevent others from turning the power back on. Service personnel must wear proper personal protective clothing and equipment.

- The motor sheave is to be positioned as close as possible to the motor in order to minimize torque on the motor bushings.
- The motor and fan sheaves may have grooves that are not used. The bottom surface of the motor and fan sheaves must be aligned within ⅛" of each other and level within ½° (⅛" in 12") in order to not adversely affect belt and sheave life.
- Alignment can be achieved by placing a straight edge across the top of the sheaves making sure that it is level and measuring down to the bottom surface of both sheaves at four points. See photo.
- The number of grooves on the motor and fan sheaves may not match each other, or the number of grooves on the belt. Always install the belts on the highest grooves on the fan sheave. Doing so will reduce the force on the fan shaft bearings, thus increasing their life.

Maintenance

Sheave Assembly Bolt Torque		
Busing Type	ft·lb$_f$	N·m
SD	5	10
SK	15	20
SF	25	30
E	35	50

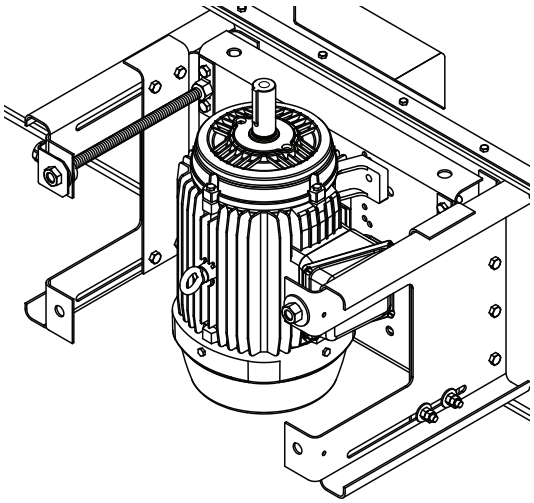


⚠ Warning

Fan Motor Access and Removal

Always shut off electrical power to the tower fan motor prior to performing any inspections that may involve physical contact with the mechanical or electrical equipment in or on the tower. Lock out and tag out any electrical switches to prevent others from turning the power back on. Service personnel must wear proper personal protective clothing and equipment.

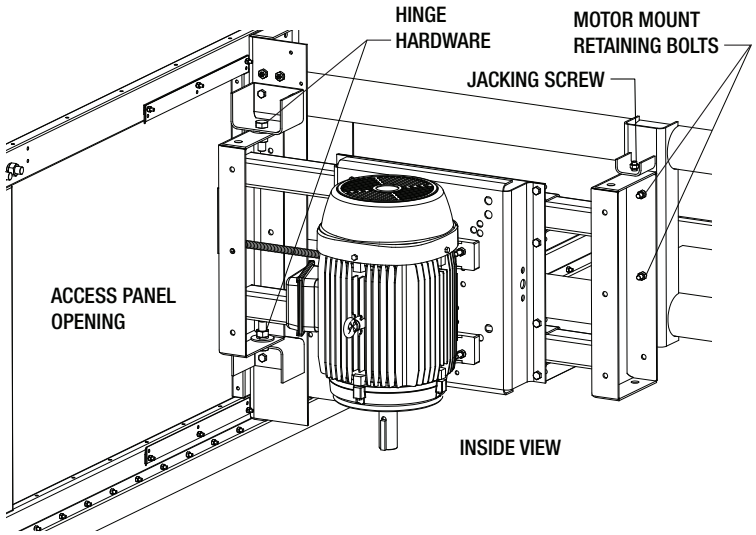
The MD fan motors are located inside or outside the tower, depending on the model. The **MD5008** and **MD5010** fan motor is located outside the tower. The motor is fully accessed by removing the motor protection hood. Remove motor protection hood and the drive belt by following the instructions in the **Belt Tensioning** section.



The **MD5008** and **MD5010** motors are oriented with the shaft up. The motor may be hoisted by threading an eye bolt into the motor shaft and lifting with a hoist. To remove the motor fastener hardware, lift on the motor slightly with the hoist to remove the weight from the fasteners, loosen and remove all hardware.

Maintenance

The **MD5016** fan motor is located inside the tower. The motor can be accessed through the mechanical access panel. See the **Access Door Operation** section for instruction on opening the access panel. For greater access to the motor, the motor mounting system can be swung outside the tower to facilitate maintenance and removal. Remove the drive belt by following the instructions in the **Belt Tensioning** section. Loosen the motor mount system retaining bolts shown in the image. It is not necessary to loosen any hardware other than what is indicated. Hinge the motor mounting system 90° out through the access panel.



The **MD5016** motor is installed with the shaft down. There is no acceptable location on the motor to hoist with the motor in this orientation. The motor should be hoisted by leaving it attached to the motor mount mechanism and removing the entire mechanism from the torque tube. After swinging the mount outside of the tower, attach the mount to a hoist with straps or chains. Lift slightly on the mount with the hoist to remove the weight from the hinge fasteners, then loosen and remove hinge hardware. Only remove the hardware shown.

⚠ Caution

Depending on the motor frame size, the center of gravity of the motor assembly mount may be off center. Always hoist from the top of the motor mount

If the motor is removed from the mounting plate, it should be reinstalled at the torques specified on the following page—do not lubricate the bolts. Reassemble the mechanical system, following the instructions above in

reverse. When fastening the motor mount mechanism to the torque tube, first insert the fasteners closest to the access panel that acts as a hinge. After tightening this hardware, swing the motor in and attach it to the torque tube. Due to the weight of the motor cantilevered on the hinge, the motor mechanism may sag. When attaching to the torque tube, it may be necessary to align the holes with the jacking screw shown in the image.

Motor Mounting Bolt Torque				
Machine Bolt Size	Galvanized		Stainless	
	$ft{\cdot}lb_f$	N·m	$ft{\cdot}lb_f$	N·m
10mm	15	20	30	40
12mm	25	35	50	65
16mm	65	85	120	160
20mm	125	170	230	315

Cold Water Basin Access / Air Inlet Louver Removal

Some maintenance procedures require access to components located in the cold water collection basin. All maintenance procedures can be performed from the perimeter of the tower therefore there is no reason to enter basin. To access the basin, one of the air inlet louver frames must be removed. To remove, loosen the thumbscrews indicated in the image below and push the louver retaining bracket up and to the left to move out of the way of the louver frame. Tip the top of the frame out from the tower, then remove. Louver frames are not the same size, if more than one louver frame is removed, the original location should be noted.

⚠ Caution

Collection basing floor has uneven surfaces and has the potential to be slippery. Care should be taken if entering the basin.

Maintenance

Access Door Operation

⚠ Warning

Always shut off electrical power to the tower fan motor prior to performing any inspections that may involve physical contact with the mechanical or electrical equipment in or on the tower. Lock out and tag out any electrical switches to prevent others from turning the power back on. Service personnel must wear proper personal protective clothing and equipment.

To allow access to the mechanical system, eliminators, water distribution system and fill surface, a access door is provided toward the top of the tower. To open, follow the following steps:

1. Remove any lock that is securing the door shut.
2. Loosen and remove the locking knob at the center of the access door panel.
3. Slide the panel with the handle sideways as far as it will travel.
4. Push the panel toward the inside of the tower. The panel will hinge to the side.

Drift Eliminator Removal and Replacement

The drift eliminators may be removed for cleaning, replacement or access to the distribution system. The eliminators are held in place by a press fit, so there is no need to remove any fasteners. However, eliminators are formed so that they nest with each other and form a monolithic barrier. Individual packs of eliminator are formed into 2'-0 wide sections that span from the casing wall to the centerline of the tower, just under the mechanical torque tube. It is recommended that personal protection is used when handling the eliminator pieces, sharp edges and corners can cause abrasions.

Maintenance

To remove the eliminator, stand inside the access panel and lift with two hands on an eliminator section, this will indicate where one section stops and another starts. Lift the eliminators at that intersection, removing two packs at one time (see image). Once the first two packs are removed, the remaining packs should be easily removed. Pay close attention to the orientation and placement, they are not symmetrical. Each pack should be replaced at the location which it was removed. Repeat this process for the second half of the tower.

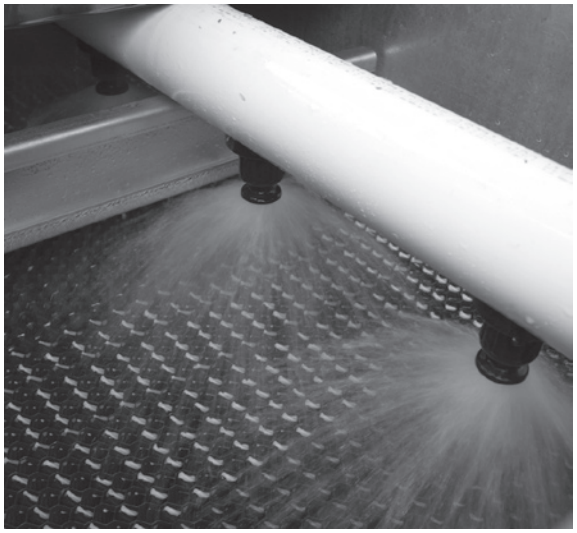
Note

Proper eliminator pack replacement is essential to tower operation. Incorrect installation may result in excessive drift rates and fan inefficiency! To ensure packs are reinstalled in the correct orientation, it is recommended that one pack is left in its original location inside the tower as a reminder of pack orientation. Place packs in the tower in the order they were removed. Packs should nest tightly with each other, leaving a level surface with no gaps. The last two packs should be installed at the same time. Place the final two packs according to the image above, and push down to complete.

Maintenance

Distribution System Maintenance

To keep your MD cooling tower operating at peak performance, it may be necessary to clear the spray system of debris or sediment. To access the spray system, remove the drift eliminators as explained in the previous section. Observe the spray system with full flow on the unit. Each nozzle should produce a cone pattern spray which overlaps the adjacent nozzle patterns—see image.



If a nozzle appears clogged or is not producing a cone patter, remove the nozzle and clean all surfaces. To remove the nozzle, pull down sharply on the plastic component, leaving the rubber grommet seated in the PVC pipe. Inspect the nozzle for cleanliness or broken pieces. Each nozzle should have a turbulator inside the outer shell—see image. If the nozzle appears broken or damaged, consult your Marley representative for replacement parts. Insert the nozzles by pressing it back into place inside the rubber grommet. It may be necessary to wet the nozzle and grommet to facilitate assembly.

It may also be necessary to remove an entire branch arm from the spray system. Each arm is held in place with a retention strap bolted to the branch arm supports. Remove the bolts attaching the strap to the support and pull sharply on the branch arm to disengage from the header box. It may be necessary to rotate the branch

arm while pulling out from the header box.

When branch arms are removed, access to the interior of the spray header box is available to clean and remove any debris or sediment. A drain nozzle at the centerline of the header box is intended to drain water from the system at shutdown, as well as be removed to wash out the header box if necessary. Be sure to replace this nozzle if removed.

Reinstall the branch arms to the header, engaging them far enough to align the bolts of the tie down strap to the spray system supports. It may be necessary to wet the rubber grommet and pipe to facilitate assembly. Ensure that all nozzles are aligned to the bottom of the branch arm.

Schedule of Tower Maintenance

Some procedures may require maintenance personnel to enter the tower. Each cell has an access door for entry into the tower. All tower maintenance can be performed from this location. An optional mechanical access platform is designed and intended solely for personnel to gain access to the motor and access door. Upon entering the tower, the eliminators and fill may be used as a walking surface for tower inspection and typical maintenance. For those instances of frequent or prolonged servicing, it is necessary to protect the surface with plywood or planking. The fan deck and fan guard are not designed as a walking or working surfaces. There are no maintenance procedures that require access to top of the tower.

⚠ Warning

The purchaser or owner is responsible for providing a safe method for entering or exiting the access door.

Included with this instruction packet are separate User Manuals on each major operating component of the tower, and it is recommended that you read them thoroughly. Where discrepancies may exist, the separate User Manuals will take precedence. The following is recommended as a minimum routine of scheduled maintenance:

⚠ Warning

Always shut off electrical power to the tower fan motor prior to performing any inspections that may involve physical contact with the mechanical or electrical equipment in or on the tower. Lock out and tag out any electrical switches to prevent others from turning the power back on. Service personnel must wear proper personal protective clothing and equipment.

Maintenance

Weekly: Inspect for bacterial growth and general operation conditions. Bacterial growth should be reported to your water treatment expert for immediate attention.

Monthly (Weekly at start up): Observe, touch, and listen to the tower. Become accustomed to its normal appearance, sound, and level of vibration. Abnormal aspects relating to the rotating equipment should be considered reason to shut down the tower until the problem can be located and corrected. Observe operation of the motor, belt, sheaves and fan. Become familiar with the normal operating temperature of the motor, as well as the sight and sound of all components as a whole.

Inspect air inlet louvers, drift eliminators and basin trash screens and remove any debris or scale which may have accumulated. Replace any damaged or worn out components. Use of high-pressure water may damage the eliminator, fill and louver material.

Observe operation of the float valve. Depress the operating lever to make sure that the valve is operating freely. Inspect the suction screen for plugging. Remove any debris that may have accumulated.

Check for any buildup of silt on the floor of the cold water basin. Mentally make note of the amount, if any, so future inspections will enable you to determine the rate at which it is forming.

View the water pattern as it exits the fill section. Consistent coverage indicates that all nozzles are flowing properly. If there are dry spot in the fill or inconsistent coverage, this may be evidence of a clogged nozzle. Inspect nozzles for blockage.

Every 3 months: Lubricate fan shaft bearings. Each cell is equipped with extended lube lines protruding through the casing adjacent to the access door. While rotating equipment by hand, grease the bearings until a bead forms around the seals—a maximum charge of 0.75 ounces is recommended. Mobil SHC 460 grease is recommended.

Maintenance

Semi-Annually: Check belt tension and condition. Adjust tensions as necessary.

Clean and disinfect cooling tower with biocides. Systems with biofouling, high general bacterial counts, or positive cultures of legionella may require additional cleaning. Refer to “Cooling Tower Cleaning” section—page 20. Consult your water treatment expert as to prudent biological evaluation testing.

For those regions that require semi-annual fill removal and cleaning, remove the fill through the fill access hatch (regional option) or the mechanical access panel. Note the orientation and location of fill blocks. They must return into the tower in the same location from which they were removed. Failure to do so may result in diminished thermal capacity.

Annually: Inspect the tower thoroughly, making maximum use of instructions given in the separate user manuals. Check structural bolted connections and tighten as required. Make preventive maintenance repairs as necessary.

Lubricate motor according to the manufacturer’s instructions. Check to see that all bolts are tight in the fan and mechanical equipment region, including the fan cylinder and fan guard. Refer to Component User Manuals for torque values.

Inspect the spray system and nozzles for any blockage. Nozzles can be removed from the grommet by pulling sharply down on the nozzles. To replace the nozzles, wet the surface of the nozzle and grommet and push nozzle back into place.

Seasonal Shutdown Instructions

When the system is to be shut down for an extended period of time, it is recommended that the entire system (cooling tower, system piping, heat exchangers, etc.) be drained. Leave the basin drains open.

During shutdown, clean the tower (see Warning, page 20) and make any necessary repairs. Pay particular attention to mechanical equipment supports.

Following each year’s shutdown and cleaning, inspect the tower’s metal surfaces for evidence of the need to apply a protective coating. Do not misinterpret grime and transient rust from the piping system as a need to have the tower painted. If relatively bright metal can be exposed by cleaning, consider that the galvanizing has remained effective. Unless there is

evidence of a generalized failure of the galvanizing, localized touch-up should be all that is required.

Note

To the extent that the galvanizing (zinc coating) still exists, paint will not adhere to it readily. Contact the manufacturer of the coating you intend to use for instructions.

Tower framework: Check casing and structural bolted connections and tighten as required.

Fan: Check fan assembly bolting and tighten as required. Use torque values prescribed in the Fan User Manual.

Fan shaft bearings: Lubricate fan shaft bearings at close of each operating season—see page 32.

Clean and lubricate motor at close of each operating season (refer to motor manufacturer's recommendations.) Check motor anchor bolts and tighten as required.

⚠ Warning

Do not start motor before determining that there will be no interference with free rotation of the fan drive.

The motor should be operated for three hours at least once a month. This serves to dry out windings and re-lubricate bearing surfaces (refer to Marley **"Electric Motor User Manual"** Manual 92-1475).

At start of new operating season, make sure bearings are adequately lubricated before returning motor to service.

Prolonged Shutdown

If shutdown period is longer than seasonal, contact your Marley sales representative for additional information.

Maintenance

SPX Cooling Technologies Services

Our interest in your MD cooling tower does not end with the sale. Having conceived, designed, and manufactured the most reliable and longest-lasting cooling tower of its class, we want to make sure that you gain the maximum possible benefit from its purchase.

Therefore, the following services are available which are intended to: assure the maximum possible service life under your operating conditions; tailor the operating characteristics to your specific needs; and maintain consistently optimum thermal performance capability. They are available by contacting your Marley sales representative.

Replacement parts: A complete stock of parts and components is maintained at one or more of the various Marley plants. In cases of emergency, they can normally be shipped within 24 hours—by air freight if necessary. However, you would obviously benefit from anticipating your need in advance, thus avoiding the cost of special handling.

Be sure to mention your tower serial number (from the tower nameplate) when ordering parts.

Periodic maintenance: You may wish to contract with SPX for regularly scheduled visits—for the purpose of inspecting and reporting your tower's condition—to make recommendations intended to prevent emergencies—and to perform maintenance considered outside the norm.

This service is not intended to replace the important function performed by your maintenance staff. Their attention assures the tower's routine operating performance, and is invaluable. However, we recognize the unusual manner in which a cooling tower performs its function—as well as the unique forces which act upon it—may be considerations which occasionally require the services of an expert technician.

Maintenance Schedule

Maintenance Service	Monthly	Semi-annually	Seasonal Startup or Annually
Inspect General Condition and Operation	x		x
Observe Operation of:			
Mechanical–motor, fan and drive mechanism	x		x
Makeup valve (if equipped)	x		x
Inspect for unusual noise or vibration	x		x
Inspect and Clean:			
Air inlet	x		x
PVC drift eliminators	x		x
Nozzles	x		x
Fan motor exterior	x		x
Check:			
Collection water basin level	x		x
Blowdown–adjust as required	x		x
Geareducer Drive (if equipped):			
Check for loose fasteners including oil drain plug			x
Check for / repair oil leaks	x		x
Check oil level	x		x
Change oil		R	
Make sure vent is open		x	x
Check driveshaft or coupling alignment			x
Check for loose driveshaft or coupling fasteners			x
Check driveshaft or coupling bushings or flex element for unusual wear		x	x
Lube lines			
Check for oil leaks in hoses or fittings	x	R	x
Belt drive (if equipped):			
Fan shaft bearing lubrication (every 3 mo.)		every 3 months	every 3 months
Check and tighten support fasteners			x
Check shaft, sheave and belt alignment			x
Check belt tension and condition		x	x
Check sheave bushing fastener torque			x
Fan:			
Check and tighten blade and hub fasteners			x
Check fan blade pitch and tip clearance			x
Check fan cylinder for loose fasteners			x
Motor:			
Lubricate (grease as required)			R
Check mounting bolts for tightness			x
Operate at least	3 hours a month	3 hours a month	3 hours a month
Basin Heater (if equipped):			
Check for proper operation of temp/low water level sensor			x
Inspect/clean buildup of contaminant from sensor		x	x
Structure:			
Inspect/tighten all fasteners		x	x
Inspect and touch up all metal surfaces			x

R — Refer to Component User Manual

Note: It is recommended at least weekly, that the general operation and condition be observed. Pay attention to any changes in sound or vibration that may signify a need for closer inspection.

Additional Information

Increased load requirements: MD towers are designed so that cells of either equal or unequal capacity can be added in the future. This allows you to compensate for the load increases that normally occur with the replacement or addition of production equipment—and still retain continuity with respect to your cooling tower system.

Tower rebuilding: SPX Cooling Technologies routinely rebuilds and upgrades cooling towers of all materials and manufacture. If your tower ever reaches the limit of its service life, we recommend that you investigate the cost of rebuilding before you routinely order a new replacement tower.

Each MD tower includes a document package containing general orientation drawings, **"MD Field Installation Manual"** Assembly Instructions, and tower component manuals. **These documents contain important information relating to safe installation and operation of the cooling tower.** Field installation is always required for fan guards, piping inlets and piping outlets. Some optional accessories, such as valves, handrails, ladders and safety cages may also require field installation. If installation details are not covered in the **"MD Field Installation Manual"** a separate installation drawing or manual for each purchased option is included in the document package along with bills of material. If you have purchased an option and can't find the appropriate installation drawing, contact your local Marley sales representative before proceeding.

In addition to these specific documents, SPX publishes numerous technical reports including more detailed information on a variety of cooling tower operation and service topics. Your Marley sales representative will be happy to give you copies of these reports at no charge.

For complete parts and service assistance, contact the Marley sales representative in your area. If you need help locating the office nearest you, please phone 913 664 7400 or check the internet at spxcooling.com.

Troubleshooting

Trouble	Cause	Remedy
Motor Will Not Start	Power not available at motor terminals	• Check power at starter. Correct any bad connections between the control apparatus and the motor.
		• Check starter contacts and control circuit. Reset overloads, close contacts, reset tripped switches or replace failed control switches.
		• If power is not on all leads at starter, make sure overload and short circuit devices are in proper condition.
	Wrong connections	Check motor and control connections against wiring diagrams.
	Low voltage	Check nameplate voltage against power supply. Check voltage at motor terminals.
	Open circuit in motor winding	Check stator windings for open circuits.
	Motor or fan drive stuck	Disconnect motor from load and check motor and Geareducer for cause of problem.
	Rotor defectve	Look for broken bars or rings.
Unusual Motor Noise	Motor running single-phase	Stop motor and attempt to start it. Motor will not start if single-phased. Check wiring, controls, and motor.
	Motor leads connected incorrectly	Check motor connections against wiring diagram on motor.
	Bad bearings	Check lubrication. Replace bad bearings.
	Electrical unbalance	Check voltages and currents of all three lines. Correct if required.
	Air gap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
	Cooling fan hitting end bell guard	Reinstall or replace fan.
Motor Runs Hot	Wrong voltage or unbalanced voltage	Check voltage and current of all three lines against nameplate values.
	Overload	Check fan blade pitch. See Fan Service Manual. Check for drag in fan drive train as from damaged bearings.
	Wrong motor RPM	Check nameplate against power supply. Check RPM of motor and gear ratio.
	Bearings overgreased	Remove grease reliefs. Run motor up to speed to purge excessive grease.
	Wrong lubricant in bearings	Change to proper lubricant. See motor manufacturer's instructions.
	One phase open	Stop motor and attempt to start it. Motor will not start if single-phased. Check wiring, controls, and motor.
	Poor ventilation	Clean motor and check ventilation openings. Allow ample ventilation around motor.
	Winding fault	Check with Ohmmeter.
	Bent motor shaft	Straighten or replace shaft.
	Insufficient grease	Remove plugs and regrease bearings.
	Too frequent starting or speed changes	Limit cumulative acceleration time to a total of 30 seconds/hr. Set on/off or speed change set points farther apart. Consider installing a Marley VFD drive for fine temperature control.
	Deterioration of grease, or foreign material in grease	Flush bearings and relubricate.
	Bearings damaged	Replace bearings.
Motor Does Not Come Up To Speed	Voltage too low at motor terminals because of line drop	Check transformer and setting of taps. Use higher voltage on transformer terminals or reduce loads. Increase wire size or reduce inertia.
	Broken Rotor bars	Look for cracks near the rings. A new rotor may be required. Have motor service person check motor.
Wrong Rotation (Motor)	Wrong sequence of phases	Switch any two of the three motor leads.

Troubleshooting

Trouble	Cause	Remedy
Geareducer Noise	Geareducer bearings	If new, see if noise disappears after one week of operation. Drain, flush, and refill Geareducer. See Geareducer Service Manual. If still noisy, replace.
	Gears	Correct tooth engagement. Replace badly worn gears. Replace gears with broken or damaged teeth.
Unusual Fan Drive Vibration	Loose bolts and cap screws	Tighten all bolts and cap screws on all mechanical equipment and supports.
	Unbalanced drive shaft or worn couplings	Make sure motor and Geareducer shafts are in proper alignment and "match marks" properly matched. Repair or replace worn couplings. Rebalance drive shaft by adding or removing weights from balancing cap screws. See Drive Shaft Service Manual.
	Fan	Make certain all blades are as far from center of fan as safety devices permit. All blades must be pitched the same. See Fan Service Manual. Clean off deposit build-up on blades.
	Worn Geareducer bearings	Check fan and pinion shaft endplay. Replace bearings as necessary.
	Unbalanced motor	Disconnect load and operate motor. If motor still vibrates, rebalance rotor.
	Bent Geareducer shaft	Check fan and pinion shaft with dial indicator. Replace if necessary.
Fan Noise	Blade rubbing inside of fan cylinder	Adjust cylinder to provide blade tip clearance.
	Loose bolts in blade clamps	Check and tighten if necessary.
Scale or foreign substance in circulating water system	Insufficient blowdown	See "Water Treatment" section of this manual
	Water treatment deficiency	Consult competent water treating specialist. See "Water Treatment" section of this manual
Cold Water Temperature Too Warm (See "Tower Operation")	Entering wet bulb temp. is above design	Check to see if local heat sources are affecting tower. See if surrounding structures are causing recirculation of tower discharge air. Discuss remedy with Marley representative.
	Design wet bulb temp. was too low	May have to increase tower size. Discuss remedy with Marley representative.
	Actual process load greater than design	May have to increase tower size. Discuss remedy with Marley representative.
	Overpumping	Reduce water flow rate over tower to design conditions.
	Tower starved for air	Check motor current and voltage to be sure of correct contract horsepower. Re-pitch fan blades if necessary. Clean louvers, fill and eliminators. Check to see if nearby structures or enclosing walls are obstructing normal airflow to tower. Discuss remedy with Marley representative.
Excessive Drift Exiting Tower	Faulty drift elimination	Check to see that integral fill, louvers, and eliminators are clean, free of debris, and installed correctly. If drift eliminators are separate from fill, make sure they are correctly installed in place. Clean if necessary. Replace damaged or worn out components.

COOLING TECHNOLOGIES

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